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# Experimental Investigation of the Performance of Different Lost Circulation Materials and Introducing a New Type of Eco-Friendly Lost Circulation Additive

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## Abstract

In this paper, a new experimental method is applied, and the capability of different Loss Control Materials (LCMs) in bentonite mud – which has the highest use in Iran's oil and gas wells – is investigated. At first, particle size distribution of LCMs is calculated based on API standards. Then, the loss of bentonite mud in different slots is evaluated using Bridging Materials Testing (BMT) apparatus. Usage of three dimensional fractures is one of the most important points of this research, which makes the experiment conditions so similar to the real conditions of well. It should be mentioned that LCMs show their best efficiency only when they can internally block the fractures. Also, in this research, RI-LQ material is for the first time used to control the lost circulation of bentonite mud. The results of these experiments showed that a mixture of RI-LQC and Quick Seal with Concentrations of 20 and 5 pounds per barrel and RI-LQC and RI-LQF mixtures with concentrations of 18 and 7 pounds per barrel have the least amount of loss circulation and are effective in controlling sever losses.

**Keywords:** Loss Circulation, LCMs, Bentonite Mud, BMT, RI-LQ.

## Introduction

Lost circulation is one of the most important concerns of the drilling industry [1]. An integrated approach for mitigating this problem reduces the formation damage and the overall well drilling and production costs [2]. Lost circulation phenomenon is described when a portion or the whole of drilling fluid enters the formation [3, 4]. It happens when either the permeability of the formation is adequately high, or the voids are as big as they cannot be blocked by solid particles inside the mud. One of the most magnificent methods to treat and prevent the occurrence of the lost circulation phenomenon is the usage of LCMs. Many works have been implemented so far to investigate various aspects of LCMs [4-11]. Based on essence, physical nature, and also mechanisms of LCMs, they can be categorized into four general sections of granular, fibrous, flaky, or a blend of all three. In this study, a new type of eco-friendly LCM in the name of RI-LQ is introduced to control different types of lost circulation for the bentonite mud [5].

## Experimental Procedures

### BMT Apparatus

In this work, the BMT apparatus has been used to evaluate the performance of various LCMs. In this apparatus, 3D fractures with 1.96 inches depth, 1.38 inches length, and 0.04, 0.08, 0.12, 0.16, and 0.2 inches width have been used for physical simulation of fractured formations. It should be uttered that most similar experiments have been performed using fractures without depth, while fractures in the apparatus used in this research are three-dimensional and have depths. Thus, the conditions are more similar to those of well, and if LCM can block a fracture from inside, it can be applicable in these fractures. The difference between fractures with depth and those without depth has been shown in Figure. 1.

**Figure 1: The comparison between old and new fractures in BMT apparatus.**

For analysis, slots were placed before output valve. Then, drilling mud with specific amounts of LCM was poured into the BMT cell (with output valve open) and the output mud volume was measured accurately. In the next step, the piston was placed on mud, and mud pressure was increased by 50 psi once every 10 seconds. It is necessary to note that the pressure is increased until either 1000 psi pressure, or the stoppage of mud flow. In cases that LCMs have succeeded to block the output passage of flow, the pressure has been kept constant for 10 minutes, and then final output volume has been recorded. At last, the experiments were repeated after changing the slots (increasing their size) until achieving eternal blockage in 1000 psi pressure, and results were used to investigate the performance of various LCMs.

### General Experiments

In this study, a standard filter press apparatus was used in analyzing the filtration properties of drilling mud and the amount of mud loss. In addition, a viscometer (model 35-FANN) was used to measure the viscosity and gel strength of the drilling fluids.

For calculating, the solubility of LCMs in acid, 10 g of all LCMs have been precisely weighted and added to 100 ml of Hydrochloric Acid 28%. Then, the ceramic sieves have been utilized to determine the amount of LCMs which could no longer dissolve in the acid.

## Results and Discussion

The effect of RI-LQC on bentonite mud loss in various fractures has been shown on Figure 2. The experiment results showed that this material presents good blockage in 0.04 and 0.08 inches fractures. It could also effectively block 0.12 inche fractures with 15 ppb concentrations. The results also show that RI-LQC exhibits an acceptable performance in 0.16 inches fractures.

However, this material is not able to effectively block 0.2 inches fracture. However, as can be seen in Figure 3, a mixture RI-LQC and RI-LQF with a concentration of 18 and 7 ppb could effectively control the lost circulation. As a result, this mixture is well capable of controlling sever lost circulations.

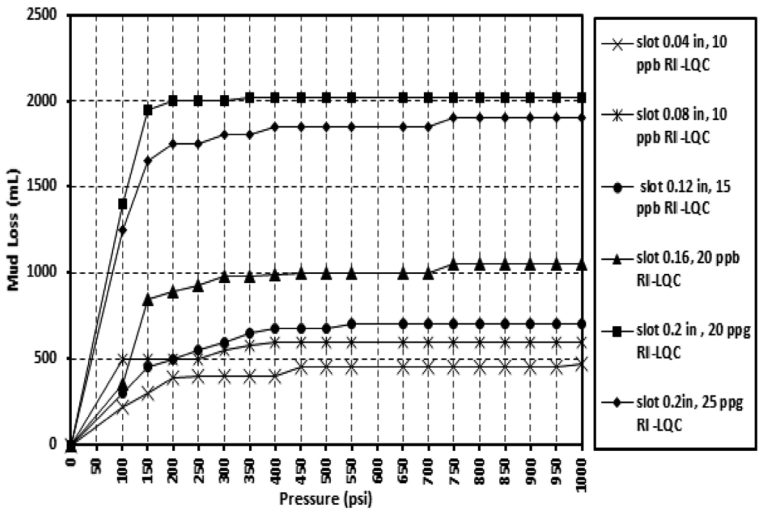


**Figure 2: The investigation of performance of coarse quick seal with various concentrations to control the mud loss in bentonite mud.**

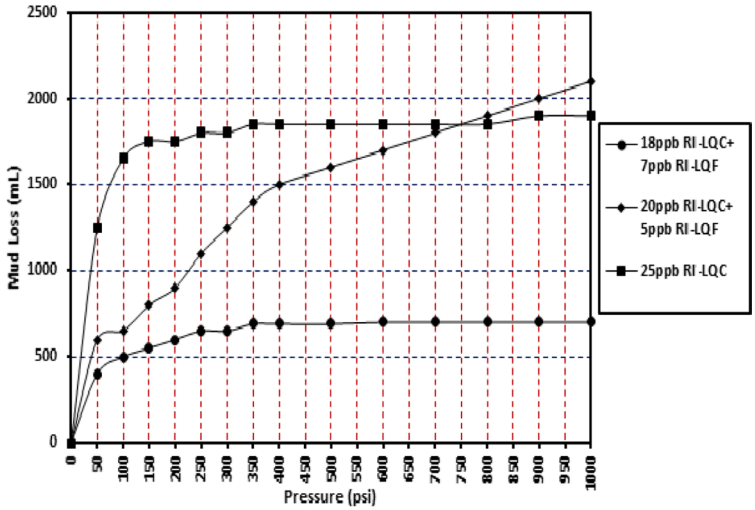


**Figure 3: The investigation of performance of RI-LQ mixtures with various sizes and concentrations, to control the mud loss.**

## Conclusions

In this study, the effectiveness of different LCMs for controlling the lost circulation of bentonite has been investigated experimentally. According to the results, mica and oyster shell alone are completely unable to control the lost circulation of fracture formations. Among all the LCMs used in this work, RI-LQC and Quick Seal Coarse showed the best performance for controlling the lost circulation of bentonite mud. The results showed that the combination of RI-LQC and RI-LQF with 18 and 7 ppb concentration is well capable of controlling the sever losses.

## References

[1]. Kumar A. and Savari S., "*Lost circulation control and wellbore strengthening looking beyond particle size distribution*," In AADE national technical conference and exhibition, Houston, Texas, USA, pp. 12-14, 2011.

[2]. Yongcun F., Jones J. F. and Gray K. E., "*A Review on Fracture-Initiation and-Propagation Pressures for Lost Circulation and Wellbore Strengthening*," SPE Drilling and Completion 31, No. 02, pp. 134-144, 2016.

[3]. Power D., Ivan C. D. and Brooks S. W., "*The top 10 lost circulation concerns in deep water drilling*," SPE 81133,Latin America and Caribbean Petroleum Engineering,Port-of-Spain, Trinidad, April 27-30, 2003.

[4]. Nayberg T. M., "*Laboratory study of lost circulation materials for use in both oil-based and water-based drilling muds*," SPE Drilling Engineering 2, No. 03, pp. 229-236, 1987.

[5]. Arunesh Kumar S. Sh., Whitfill D. L. and Eugene Jamison D., "*Improved lost circulation treatment design and testing techniques minimizes formation damage*," In SPE European Formation Damage Conference, Society of Petroleum Engineers, 7-10 June, 2011.

[6]. Nasiri A. R., Ghaffarkhah A., Keshavarz Moraveji M., Gharbanian A. and Valizadeh M., "*Experimental and field test analysis of different loss control materials for combating lost circulation in bentonite mud*," Journal of Natural Gas Science and Engineering, Vol. 44, pp. 1-8, 2017.

[7]. Corley Wallace T. and Dorsey D. L., "*Lost circulation material*," U.S. Patent 4,422,948, issued December 27, 1983.

[8]. Lummus J. L. and Randall B. V., "*Lost circulation material*," U. S. Patent 3,375,888, issued April 2, 1968.

[9]. Goud M. Ch. and Joseph G., "*Drilling fluid additives and engineering to improve formation integrity*," In SPE/IADC Indian Drilling Technology Conference and Exhibition, Society of Petroleum Engineers, 2006.

[10]. Mokhtari M. and Ozbayoglu E. M., "*Laboratory investigation on gelatin behavior of Xanthan cross-linked with Borate intended to combat lost circulation*," Society of Petroleum Engineers, SPE 136094, 2010.

[11]. Dick M. A., Heinz T. J., Svoboda C. F. and Aston M., "*Optimizing the selection of bridging particles for reservoir drilling fluids*," In SPE International Symposium on Formation Damage Control, Society of Petroleum Engineers, 2000.